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ABSTRACT

Experiments were conducted to test the effectiveness of self-instructional programs to teach the operation of two pieces of technical equipment, SAGE track monitor and intercept director. Three groups of trainees completed each program: (1) naive trainees; (2) trainees familiar with other components of SAGE; and (3) trainees with limited on-the-job experience. A fourth group of experienced personnel were given the same proficiency exam without participating in the training program. Results support the feasibility of using self-instructional materials for on-site initial training, cross-training, and transition training. Proficiency test results, opinion questionnaire results, and other pertinent data are included. (EMH)

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EVALUATION OF TWO PROTOTYPE SELF-INSTRUCTIONAL PROGRAMS COVERING BASIC JOB KNOWLEDGE FOR SAGE TRACK MONITOR AND INTERCEPT DIRECTOR OPERATOR POSITIONS

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FOREWORD

This is one of a series of seven reports prepared by the American Institute for Research under Contract AF 19(604)-5951, Development of optimal methods of organizing and presenting SAGE operator job information in self-training equipment. The complete series is listed below, with authorship, title, and report number indicated for each document.

1. Shettel, H. H., Angell, D., Fazio, Janet L., Lindley, R. H. & Lumsdaine, A. A. Training requirements for the development of prototype self-instructional programs covering basic job knowledge for SAGE Track Monitor and Intercept Director operator positions. Pittsburgh: American Institute for Research, 1961. AIR-C11-61-SR-246 (ESD-TN-61-52)

2. Shettel, H. H. & Lumsdaine, A. A. Principles of programming as applied to the development of two self-instructional programs for SAGE operators. Pittsburgh: American Institute for Research, 1961. AIR-C11-61-SR-247 (AFCCDD-TN-61-27)

3. Shettel, H. H., Angell, D. & Lumsdaine, A. A. Handbook for the preparation of self-instructional materials for SAGE operators. Pittsburgh: American Institute for Research, 1961. AIR-C11-61-SR-248 (AFCCDD-TN-61-30)

4. Shettel, H. H. & Lumsdaine, A. A. Characteristics of self-instructional devices to meet training requirements for the SAGE Track Monitor, Intercept Director, and related system-operator positions. Pittsburgh: American Institute for Research, 1961. AIR-C11-61-SR-249 (ESD-TN-61-47)

5. Shettel, H. H. Evaluation of two prototype self-instructional programs covering basic job knowledge for SAGE Track Monitor and Intercept Director operator positions. Pittsburgh: American Institute for Research, 1961. AIR-C11-61-SR-250 (ESD-TN-61-51)

6. Shettel, H. H. & Lindley, R. H. An experimental comparison of two types of self-instructional programs for a SAGE system paired-associate task. Pittsburgh: American Institute for Research, 1961. AIR-C11-61-TR-251 (AFCCDD-TN-61-20)

7. Shettel, H. H., Angell, D. & Lumsdaine, A. A. FINAL REPORT (Short title) Self-instructional programs for SAGE system operators. Pittsburgh: American Institute for Research, 1961. AIR-C11-61-FR-252 (ESD-TR-61-17)

The project staff wishes to acknowledge the cooperation of the military agencies and personnel contacted, and the close support provided by Dr. Walter Organist and Dr. Sylvia Mayer, of the monitoring agency. Captain Raigh Mason and Mr. Ira Goldstein, also of the monitoring agency, were particularly helpful in assisting in the conduct of the field evaluation of the completed programs.

Members of the research staff of the American Institute for Research who made major contributions to various phases of the work done under this contract include: Arthur A. Lumsdaine (Principal Investigator), Harris H. Shettel, David Angell, Janet Fazio, and Richard Lindley.

ABSTRACT

A short description of the Track Monitor (TM) and Intercept Director (IND) self-instructional programs and materials, covering basic job knowledges and skills, is followed by a detailed examination of the results obtained from on-the-site field trials of the completed programs. Three groups of trainees completed each program: (1) naive trainees who had no SAGE experience at all; (2) cross-trainees who were proficient in other areas of SAGE but who had no TM or IND experience; and (3) new trainees who had received TM or IND training but had very limited experience on the job. A fourth group of experienced TM and IND personnel were given the proficiency tests but did not participate in the training programs.

Proficiency test results and opinion questionnaire results for all training groups are presented in detail; other pertinent data, such as training time, response errors and experience levels of the trainees, are examined. Relationships among some of these factors are tested and discussed.

All training groups averaged 83% on the proficiency tests. Training time averaged 15 hours for the TM program and 19 hours for the IND program. Experienced personnel scored an average of five percentage points lower on the proficiency tests than the new and cross-training groups in both programs; they averaged five percentage points higher than the naive training groups for both programs. These results support the feasibility of using self-instructional materials of the type described for on-the-site initial training, cross-training, and transition training purposes.

The programs are critically evaluated and implications are drawn from the field trial results for the future application of similar programs in military settings.

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I. INTRODUCTION

There are a number of reasons why one may want to use self-instructional, rather than more conventional training programs. Such programs may, for example, be considered more convenient since trained instructors and large classrooms are not needed. But a consideration such as this should almost always be relegated to secondary importance. The primary justification for using self-instructional techniques is their potential ability to teach effectively and efficiently, i.e., to achieve high levels of learning in relatively short periods of time. This report answers questions concerning the effectiveness and efficiency of two self-instructional programs developed to teach basic job knowledge for SAGE Track Monitor (TM) and Intercept Director (IND) operator positions.

As noted in the Foreword, other reports in this series cover in detail other aspects of the work done under this contract. However, a brief review is given here of the nature of the programs and the scope of their coverage so that the discussion of results can be more fully understood without immediate reference to these other documents.

The programs covered the following areas for both operator positions:

1. A general understanding of what SAGE is, how the specific task being covered (TM or IND) fits into SAGE and how it interacts with related SAGE tasks.

2. Knowledge of all the symbology (situation display and digital) normally used in the performance of the task.

3. Knowledge of the use of all buttons and switches on the console equipment (including the Auxiliary Console for the IND) that are normally used in the performance of the task.

4. Ability to read and interpret a flashing situation display of moderate complexity.

5. Ability to perform all actions required by the task, including the knowledge of when to perform them and why they should be taken.

These areas involved the following kinds of behaviors and skills:

1. Job knowledge (academic) skills
2. Decision-making skills
3. Problem-solving skills
4. Perceptual skills
5. Positional-motor skills
6. Symbol identification skills
7. Sequential skills

The self-instructional program itself was composed of lengthy sequences of small steps in continuous-discourse format, utilizing a variety of response modes, including the following:

1. Overt-composed (written) responses.
   a. Self-corrected. After writing his answer, trainee then discloses the correct answer for comparison and judges whether his answer was right or wrong.
   b. Matched. After writing his answer, trainee discloses several possible answers and then indicates which one his answer matches.

2. Covert-composed (mental) responses.
   a. Self-corrected.

b. Matched.

(Same as 1-a and 1-b, respectively, except that trainee merely thinks his answer instead of writing it.)

3. Selective responses.

a. Conventional multiple choice. Trainee chooses one of a small number of selected alternatives.

b. Extended (universe) selection. Trainee selects proper response from the universe of all possible relevant responses; thus, in a sense he is constructing his response rather than merely recognizing it as in 3-a.

4. Pointing-selection responses.

a. Conventional multiple choice.

b. Extended (universe) selection.

(Like 3-a or 3-b, except that instead of choosing from a list of symbols, words, etc., trainee in effect points to the relevant part of a pictured console or display.)

5. Manual and perceptual responses on console mock-ups. Trainee is asked to perform at his console mock-up, i.e., to take certain switch and button actions and/or make an interpretation of symbols and radar data on his display scope. He is then shown the correct switch positions or is given the correct scope interpretation. Both the self-corrected and matched-response format can be used.

Approximately one half of the frames in both programs were of the overt, write-in type. The other half were selective, pointing, covert-composed, etc. The two types of teaching machines utilized (one of which was designed and built specifically for the presentation of these materials) made it possible to intermix response modes in whatever way was deemed desirable, i.e., an overt written response could be followed by a multiple choice response, etc.

In addition to providing for the random intermixture of response modes, the device experimentally developed for this contract also provided for limited branching (by-pass) sequences. These were employed in the IND program only.

A good deal of the symbology needed by TM and IND operators was covered in paired-associate, or flash card format. This discrete-item material was not part of the main body of the program. The flash cards were bound in separate booklets which were used for scheduled periods of time.[1]

The self-instructional program materials for both devices were prepared on individual cards. Both devices were self-paced and cheat proof. They presented the cards (frames) to the trainee one at a time. The TM program consisted of 1,702 frames and the IND program consisted of 2,444 frames. (These figures do not include the flash card materials.)

Console simulation was provided by mock-ups containing most of the console switches and module buttons. These mock-ups also contained a simulated flashing display which intended to achieve the training objective of teaching perceptual skills.

Figure 1 shows the arrangement of four training stations as they were set up for the on-the-site, field evaluation trials. The four training stations were independent of each other. Two TM programs (top and bottom stations) and two IND programs (left and right stations) could be run simultaneously with each trainee working at his own pace and with his own complete set of materials.

The IND station on the left is shown with the teaching machine and cheat proof tape write-in device developed under this contract. The other stations are using the nonbranching teaching machines. Two of these stations have the tape write-in units; the trainee at the lower station has no such unit and is recording his answers in a notebook. Trainees were assigned to an appropriate station at the beginning of the program and continued to return to the same station until they completed the program.

[1] An experimental study comparing three versions of a flash card format and three versions of a continuous-discourse, small step format, covering a discrete-item, paired-associate task (phonetic alphabet), is reported in detail in AFCCDD-TN-61-20.

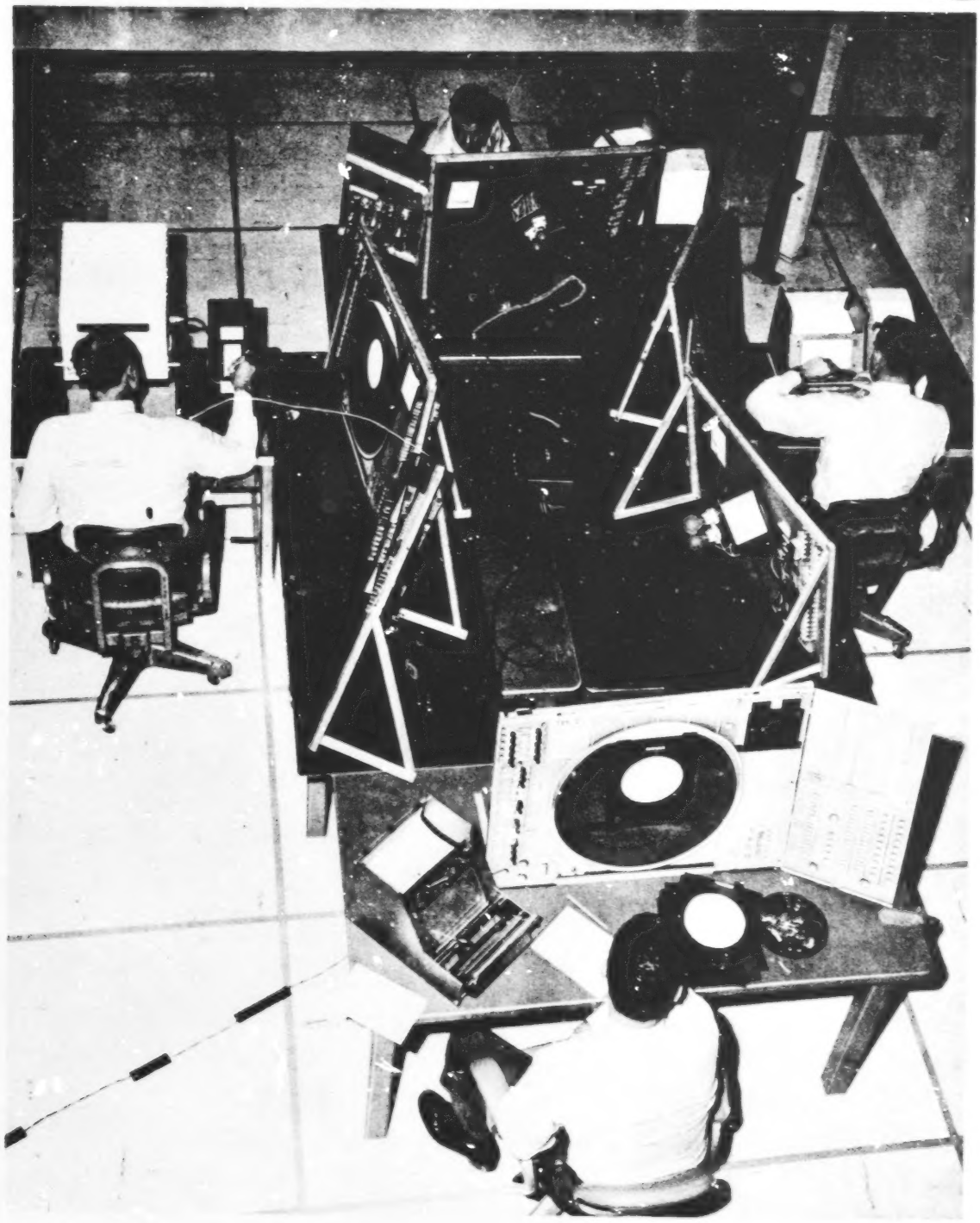

Fig. 1. Overall view of field installation of four SAGE self-instructional training stations, showing two Track Monitor (top and bottom) and two Intercept Director (left and right) simulated console mock-ups.

II. PROGRAM EVALUATION

This section of the report describes the nature of the various subject groups who comprised the training population, describes the test results for the experimental and control subjects, and discusses other relevant data collected from the field trials of the two self-instructional programs.

Subject population.

As originally conceived, both self-instructional programs were designed to teach basic job knowledge to trainees who knew nothing about the TM or IND positions, or indeed, did not necessarily know anything about SAGE in general. This was a working assumption designed to test the effectiveness of the programs under the most severe conditions, i.e., when presented to completely naive subjects. In testing the feasibility of using such programs for various on-the-site applications, however, it was also appropriate to consider them as cross-training programs and as interim training programs, i.e., as training for individuals who were being retrained from their present position to the TM or IND position and for individuals who had recently graduated from a SAGE training school but had not yet been qualified as an IND or TM operator. Thus, three groups of subjects were required for each program:

a. "New" subjects who had a minimum amount of job experience and who had recently graduated from SAGE training schools.

b. Cross-trainees who had no TM or IND job experience but who were qualified in other SAGE positions.

c. Naive trainees who had neither job experience nor general SAGE experience.

These three groups would answer three questions about the program: (1) How well would such a program work as the sole method of bringing potential TM and IND operators up to a level of performance which would make it possible for them to

assume the duties of an operator in a minimum amount of time? (2) How well would such programs work as a means of providing for the transitioning of personnel from one operator position to another within a site? (3) How well would such programs work as transitional training units providing for the training of additional skills and behaviors subsequent to graduation from training schools but prior to assuming job duties?

Working within an operational setting made it difficult to obtain subjects who had, or approached, the various experience requirements and who could devote the amount of time required to complete the program, testing, etc., (an average of 17 hours). However, four subjects completed training in each group for each program except the naive group for the Track Monitor program. Only two subjects completed the program in this group. Thus there were four subjects in five of the six training groups and two subjects in the remaining group for a total N of 22.

Table 1 shows the number of months of experience each subject had in the area for which he was being trained ("Program Related Experience") and in SAGE in general. Trainees for the "new" group for each program were the most difficult to obtain and as a result some of the subjects in these groups had considerable prior experience at their respective tasks. This was especially true of Subject 3 in the Track Monitor program and Subject 4 in the Intercept Director program. The background experience of the trainees was accounted for partly in the manual system. The positions for which the cross-trainees were currently qualified are noted in Table 1 under the months of experience. Thus, Subject 1 in the TM cross-training group had nine months of general SAGE experience, most of which was devoted to the Manual Inputs room. Subject 4 in the IND cross-training group had 60 months of background experience in SAGE and was qualified as an Identification Officer.

An attempt was made to obtain naive subjects representative of individuals who might be selected for these occupations by the Air Force. This was accomplished for the IND program by using college level trainees. These subjects were paid a stipend for participating in the study. With one exception all naive subjects

Table 1

Experience Levels of Trainees for Each Training Group

		Program Related Experience in Months (as TM or IND)				General SAGE and Manual Background Experience in Months			
	Subjects →	S-1	S-2	S-3	S-4	S-1	S-2	S-3	S-4
Track Monitor Trainees	"New"	3	1	32	.25	7	11	32	2
	Cross	0	0	0	0	9 (MI)	5 (TI)	5.5 (IDT)	16 (TT)
	Naive	0	0	--	--	0	0	--	--
Intercept Director Trainees	"New"	.03	3	1	8	24	3	24	18
	Cross	0	0	0	0	4 (TM)	24 (IDO)	3 (IDO)	60 (IDO)
	Naive	0	0	0	0	0	0	0	0

exhibited a high degree of interest in the subject matter. One subject showed marked apathy toward the IND program and gave these instructional materials their severest test. It is not at all likely that an individual with this level of interest would be selected as a candidate for the Intercept Director position. In general it may be assumed that naive subjects would tend to have less direct involvement with the program and thus presumably be less motivated to learn than would subjects who could make some practical use out of the knowledge gained by successfully completing the program.

The two subjects in the naive TM group deviated from the two major requirements initially specified for these groups, i.e., they were not completely naive and they were of higher educational background than the average TM. Both of these subjects had been exposed to SAGE materials and were at least familiar with some of the terminology and certainly with the broad concept of SAGE.

With the exception of the naive subjects, all subjects were personnel stationed at the Direction Center of the Washington Air Defense Sector. Personnel participated in the program during regular duty hours. The amount of time spent on the program per session was controlled by operational requirements of the Direction Center rather than by optimal units of instruction. In general, training periods averaged about two hours, but interruptions were necessarily rather frequent.

Proficiency test results.

Shortly after the completion of the training program, each subject was given a proficiency test. Copies of these tests are reproduced in Appendices A (TM test) and B (IND test). All items on these tests were of the open-ended completion type. Test questions were directly related to the material taught in the program and fundamental to an understanding of each task. Basically each test was a sample of the trainees ability to perform skills and demonstrate his knowledge in the areas covered by each program.

A performance test was not used. It is believed, however, that a high correlation would exist between a trainee's ability to list in essay fashion the steps he would go through to take an action and his basic ability to perform that action.

In addition to the three training (experimental) groups previously noted, an additional nontraining (control) group of subjects was given only the proficiency tests as a basis for comparing test scores with those who had received the training materials. This experienced group was represented by the most proficient personnel (as judged by their supervisors) from both the Track Monitor and Intercept Director positions. Five experienced subjects were obtained for each test. The TM experienced group averaged 18.8 months on the job. The IND experienced group averaged 13 months on the job. In addition, both groups had an average of 34 months of background experience in the SAGE and manual systems.

The test results for all groups are shown in Table 2 as the percent of total points received by each subject. Total possible points equals 101 for the TM test and 168 for the IND test.

Table 2

Percent Items Correct on TM and IND Tests for
Experimental and Control Subjects

			Subjects →	S-1	S-2	S-3	S-4	S-5	Group Mean
Track Monitor Test	Experimental	"New"		91.1%	88.1%	85.0%	88.1%	---	88.1%
		Cross		77.2%	82.2%	85.1%	86.1%	---	82.6%
		Naive		70.3%	91.1%	---	---	---	80.7%
			Total Mean						83.8%
	Control	Experienced		72.5%	83.3%	81.4%	79.4%	77.4%	78.8%
Intercept Director Test	Experimental	"New"		72.9%	91.7%	86.3%	94.9%	---	86.4%
		Cross		78.9%	94.0%	97.0%	87.2%	---	89.3%
		Naive		82.7%	56.3%	62.8%	85.7%	---	71.9%
			Total Mean						82.5%
	Control	Experienced		77.1%	88.1%	85.7%	78.3%	92.3%	84.3%

Both self-instructional programs were shown to be effective methods of instruction for Track Monitor and Intercept Director basic job knowledge. In view of the fact that the tests covered only material essential to the performance of either task, the relationship between the experienced groups and training groups is particularly revealing. While the N for the groups is not large, the length of the programs provides an extended sample of trainee behavior which makes the individual scores quite meaningful. The most dramatic difference in test scores would naturally be expected between the experienced and naive groups. However, two of the five experienced IND subjects scored lower on the test than two of the four naive IND subjects. One of the two naive TM subjects scored higher than any of the experienced subjects. (This naive subject had had previous exposure to SAGE materials, but nothing that could be considered as relevant to any particular SAGE task.)

Naive IND Subject 2 was noted earlier as one who showed a very low level of interest in (and presumably aptitude for) the subject matter. Average results for all groups are shown in Figure 2.

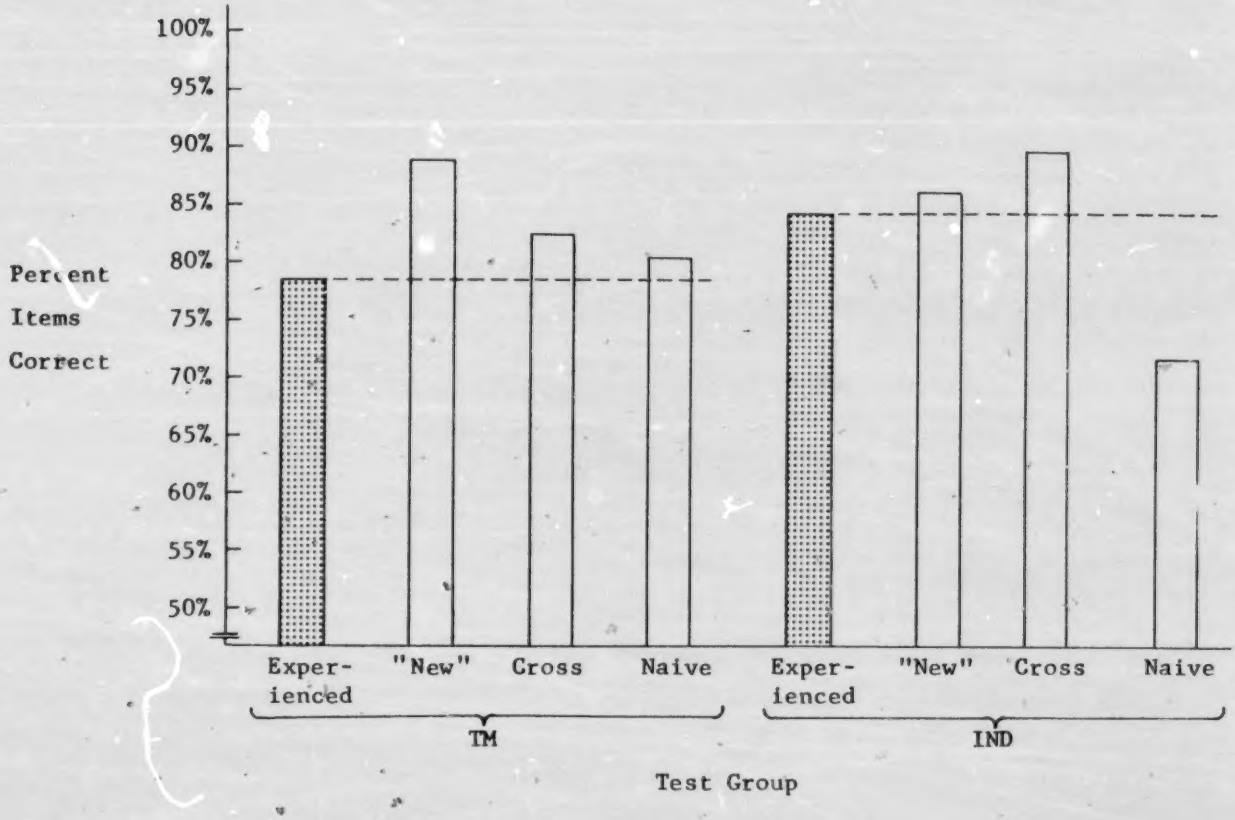

Fig. 2. Average test results for each group.

A possible contributing factor to the unexpectedly low scores of the experienced groups is that proficient operators may have difficulty in explaining or verbalizing what they do on their job. Those who participated in the training programs only recently had had a great deal of practice in writing descriptions of actions, etc., when they took the test. The effect of recent and extensive practice in verbalizing

job operations would tend to favor the experimentally trained groups. This effect would be expected to have a much greater influence, however, if the training programs were concerned with aspects of the jobs which were only infrequently encountered by proficient operators. This, of course, was not the case since the two programs covered only areas that are most frequently used by operational personnel.

Motivational effects might also have played a role in the test results since presumably those who had completed the training program would be more closely involved in the test procedures than those persons who had been called in simply to take another test. (Test taking of various kinds is a rather frequent occurrence for Direction Center personnel and this activity, when isolated from the training programs, may have been more aversive to the experienced group.)

These factors, while perhaps exerting an influence on the results, would not be expected to mask the main effect of the programs. A reasonable conclusion would be that a substantial amount of basic job knowledge was taught by both programs.

The relationship between the test scores reported here and other program variables will be discussed in a later section.

Questionnaire results.

Immediately following the end of the training period, and just preceding the administration of the tests, a questionnaire was presented to all experimental subjects. A copy of this questionnaire is contained in Appendix C. The aim of this questionnaire was to evaluate the opinion of the subjects with respect to the programs in particular and to the self-instructional concept in general, particularly as it would apply to future military training programs. A total maximum possible score on the questionnaire was 27 points, indicating the most favorable reaction. Table 3 shows the results of the administration of this questionnaire to the experimental subjects by training group in terms of the percentage obtained of the total possible score.

Table 3

Percentage Score on Opinion Questionnaire
for All Experimental Subjects

	Subjects →	S-1	S-2	S-3	S-4	Group Mean
Track Monitor Program	"New"	81.5%	48.1%	74.1%	66.7%	67.6%
	Cross	70.4%	74.1%	77.7%	62.9%	71.3%
	Naive	70.4%	85.2%	---	---	77.8%
	Total Mean					72.2%
Intercept Director Program	"New"	59.2%	48.1%	55.5%	70.4%	58.3%
	Cross	81.5%	55.5%	85.2%	85.2%	76.8%
	Naive	92.6%	85.2%	81.5%	81.5%	85.2%
	Total Mean					73.4%

While all subjects tended to respond favorably to the questionnaire, the naive subjects, as a group, scored the highest. Nevertheless, the degree to which these programs were accepted by military personnel and in many cases strongly recommended as a method that should be applied to future training programs, is gratifying. Fourteen out of 22 (64%) of the trainees would recommend that at least half of the future military training programs be of the self-instructional variety and 15 out of 22 (68%) of the trainees indicated that they liked self-instructional programs better than the conventional type of training programs. None of the trainees would recommend that no self-instructional programs be used for future training. This constitutes a rather strong endorsement of the concept, which was based not on a few hours exposure to it, but on a quite lengthy training period. While everyone had some unfavorable comments to make about specific parts of the program, or the fact that the device they were using did not always work as it should have, the general evaluation was, "This seems to be a pretty good method of training and more use ought to be made of it."

While there is always the possibility that questionnaire data tend to reflect what the subject thinks the experimenter likes to hear, experience with Direction Center personnel would not support this notion. Individuals contacted throughout the development of program materials for technical and other assistance were always severely (but helpfully) critical of all aspects of the work. There is no reason to believe that the trainees who participated in this study would not have been equally critical of the resulting programs.

Since the responses to Questions 1 and 2 on the questionnaire are particularly relevant, a breakdown of these two items is contained in Table 4.

Following the general trend of the questionnaire results, the TM and IND new groups responded less favorably to the two questions than did the other groups, while the TM and IND naive groups tended to respond most favorably. Thus there would appear to be an inverse relationship between amount of direct experience and knowledge with the job and the attitude toward self-instructional programs. This relationship, and others, between questionnaire results and other program data collected, will be discussed in a later section.

The final question on the questionnaire requested that trainees make, in their own words, whatever comments they would like concerning the program, the devices, etc., either positive or negative in nature. Many of these comments were quite revealing and excerpts from some of them are listed below.

"Question 18. In the space below we would like you to write down any additional comments concerning the program that you would like to make. Feel perfectly free to express your opinion, whether it involves something you found particularly good or bad."

TM Naive: "There was too much repetition of certain types of responses that serve no useful purpose for proper instruction."

"Wish questions could, now and then, have been more challenging; e.g., ask a question that requires logic or even just a guess. Program as is is too soporific."

Table 4

Responses to Two Questionnaire Items
Categorized by Training Group

1. Think for a moment how the material covered in this program could have been covered in a conventional training program, where you would be in a class with 15 or 20 other trainees, listening to lectures, watching demonstrations, reading assignments from manuals, etc. How would you say the present program would compare with this more conventional type of program?

TM "New"	TM Cross	TM Naive	IND "New"	IND Cross	IND Naive	Total N	%	
--	2	--	--	3	2	7	32%	I like this kind of program a lot more.
1	2	2	1	--	2	8	36%	I like this kind of program a little more.
1	--	--	--	1	--	2	9%	I like them about the same.
1	--	--	2	--	--	3	14%	I like the conventional training program a little more.
1	--	--	1	--	--	2	9%	I like the conventional training program a lot more.

Table 4 continued

2. Based on your reaction to the present program, what type of program would you recommend be used by the Air Force for future training courses?

TM "New"	TM Cross	TM Naive	IND "New"	IND Cross	IND Naive	Total N	Total %	
--	--	--	--	1	1	2	9%	I would recommend that almost <u>all</u> programs be of the new type.
1	2	1	--	1	2	7	32%	I would recommend that the majority of programs be of the new type, with a few programs of the conventional type.
1	--	1	2	1	--	5	23%	I would recommend that about half be of the conventional type and about half of the new type.
2	2	--	2	1	1	8	36%	I would recommend that the majority of programs be of the conventional lecture, demonstration type, with a few programs like the one I just completed.
--	--	--	--	--	--	0	0%	I would recommend that almost <u>all</u> programs be of the conventional lecture, demonstration type.

TM "New": "I like the program, but I feel that it would help or go well with the conventional type of instruction, like myself, I went through SAGE school, but I feel that this new method has helped me in getting refreshed and getting information I might have missed in school."

TM Cross: "I based my opinions on the program as a whole, on a person who has never had any previous SAGE training. I feel that the program in its present form is excellent for this type of person. Anyone with any SAGE training prior to being administered this program -- I feel the program is a little repetitious."

"As far as the program is concerned with, its one of the best I've taken. Your method of explaining and emphasizing a point is terrific. It's the best method for teaching new systems. In particular, I like the way most of your "fill the word" questions were displayed. I think a little more time should be spent on how to improve your presentation of your questions, but I'd prefer to learn from systems such as this than the classroom lecture, type sort of thing."

IND Naive: "It seemed that toward the end, the program cards were a little too verbose. There were a few ambiguous questions -- but not many. I think that for myself, this method of teaching taught me things I could not have learned as readily, if at all, in another method such as lectures, reading, demonstrations, etc."

"The material in the program was interesting to me. I enjoyed this method of instruction very much. However, I don't believe you can use this method on all subject matter because lectures give you more opportunity to ask questions about points you don't understand or would like to see more examples."

IND "New": "The whole system's basic idea is good. A person likes to manipulate gadgets and actually perform tasks while learning; he learns faster and remembers longer. A disadvantage in this system as compared to conventional methods is there is no opportunity for discussion with someone who is more experienced in the particular area of study. A lot can be learned from discussions and questions with the instructor or fellow student."

"The program should be administered to only people who do not have any SAGE experience -- I found it to be too repetitious and striving for too much detailed information. However, I did enjoy the simplicity used to present the pertinent information. This is a tremendous help to a beginner."

IND Cross: "In general this method of training is very good in that it is convenient and an individual can progress at his own rate of speed. He need not wait for people slower comprehending items, nor may he be snowed by faster learning individuals. This material and these devices would serve as great helps in instructing an individual into each branch of the D. C."

Other program data.

In addition to test scores and the opinion questionnaire results, other data were collected which pertained to various internal measures of performance.

a. Training time.

A question of considerable interest to those developing and/or assessing training materials concerns training time. Two measures of time were obtained for the TM and IND self-instructional programs. One was in terms of the number of hours actually spent with the programs, and the other the number of days it took to complete the programs. The latter measure, of course, is a function of the general scheduling of the training and has no necessary relation to absolute time exposed to the program. As previously indicated, the field trials could not interfere in any way with Direction Center operations, and it was therefore difficult

to obtain subjects for extended periods of time on any given day. In addition, rotating crew schedules result in personnel periodically being off duty for a few days and consequently unavailable for training during these periods. Interruptions such as these in the training schedule, unavoidable as they were, tended to have a disruptive influence on the continuity of the programs and resulted in average times of 14 days to complete the TM program and 12 days to complete the IND program. It is anticipated that scheduling would be less erratic were such programs fully integrated into the operational setting as standard on-the-site training courses.

In view of the above, a more meaningful measure of training time is the number of hours actually spent working with the materials. Table 5 shows the average training times in hours for all groups of trainees along with the standard deviations of these times. As expected, self-pacing is seen to result in some variations in the speed with which individuals progress through these materials, particularly for the IND program. In the time it took some to complete the entire program, others had completed only 65% of the program. If a fixed paced regime were imposed on both the faster and slower performers (one compromised between the upper and lower time limits), it would still require 18% more time for the slow performer to complete the materials and 18% less time for the fast performer to complete the materials. Differences of this order of magnitude would almost certainly adversely affect the proficiency of the slow performer and perhaps the fast performer as well. The interest level of the fast performer, who would probably find such a slow pace boring and fatiguing, would undoubtedly be adversely affected.

If the overall average hour time for each program is reduced to a per frame basis, it is found that trainees spent about as much time per frame in the TM program (.53 minutes) as they did per frame in the IND program (.47 minutes).[1]

[1] These figures are computed by dividing the total training time in minutes by the number of frames in the program.

Table 5

Average Times Required for All Training Groups
to Complete Each Program

		Training Groups			
		"New"	Cross	Naive	Mean
Track Monitor Program	Time in Hours	11.45	13.90	16.48	15.17
	S. D.	1.90	2.70	1.00	1.87
Intercept Director Program	Time in Hours	15.88	15.65	25.92	19.15
	S. D.	3.50	2.10	4.20	3.27

Experience with the administration of these programs indicates that a single maximum training session would be on the order of two to three hours. If a morning and afternoon session were scheduled (not necessarily recommended, but possible where time is a critical factor), four to six hours of training could be accomplished in a single day. This would mean that the TM program could be completed in three to four days and the IND program in four to five days. A more comfortable pace would increase these times by a few days.[1] In these relatively short time periods a thorough grounding is received by the trainee in

[1] Additional time spent with special review materials or in repeating certain portions of the programs would also add small increments of time. As more studies are completed using self-instructional materials in different sequences, it may be found that additional drill of this sort is an effective method of building even higher levels of terminal proficiency and/or extending the retention period of skills and behaviors learned.

the knowledges, skills, and behaviors associated with either the TM or IND task. The efficiency of these programs is thus seen to be of a rather high order.[1]

Since this type of training material results in relatively close confinement of the trainee to a small area, attention must be paid to proper lighting of the materials, comfortable seating, etc. Fatigue becomes an important element in programs requiring concentrated attention for extended periods of time.

b. Response errors.

Self-instructional programs are generally designed so that subjects make a minimum number of errors. Internal program revision and program tryout before the materials are put into use are methods which indicate those areas of the program which may be confusing to the subject, and these are rewritten and tried out again until subjects go through them without making any mistakes. While this

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[1] Care must be exercised in discussing program efficiency. The use of composite scores which result from dividing amount learned by time spent in learning to indicate the efficiency of a given technique or method of instruction as compared with the efficiency of some other technique or method of instruction can easily be misleading. Unless all subjects reach a set criterion of learning, or unless the acquisition rate of learning can be demonstrated to be linear, the resulting efficiency scores will be spuriously high or low. It is perhaps more realistic to decide whether or not one will accept a score of 80% on a given proficiency test in return for a certain level of effort (time in training, cost, etc.) as compared with a score of, say, 90% for another level of effort using a different method. Statements as to which method is the most efficient are difficult to support. For example, advancing from 80% to 90% on a proficiency test may take twice as long in units of training time as advancing from 70% to 80%. If this were the case, the method that reached the lower level would be inaccurately ascribed as the most efficient.

In any case, comparisons of the IND and TM programs with standard training methods, whether in terms of efficiency or in terms of single measures, were not considered appropriate since the contents of the programs would not be comparable and the methods of assessing terminal proficiency and program objectives would not be compatible. This report is concerned with results, primarily the amount learned and time spent in training, for the two SAGE programs. Other reports in the series state what was taught (ESD-TN-61-52) and how it was taught (AFCCDD-TN-61-27 and ESD-TN-61-47). Those who wish to do so can make their own evaluative comparisons based on these reported descriptions and results.

process certainly reduces the number of errors, it does not eliminate them entirely since individual differences continue to play a role in program performance. Of concern to the programmer, then, is the number of mistakes trainees make as they go through the complete program under field conditions. This information was obtained from a sample of the written responses, which was one of the important response modes used in both programs. A total of 192 written responses from the TM program and 156 responses from the IND program were analyzed for all subjects. These responses were selected from an early segment, a middle segment, and the end segment of each program. Any deviation from the correct term called for in the program (with the exception of spelling errors) was considered an error. Table 6 shows the results of this analysis.

Table 6

Percent Written Response Errors for All Subjects
on Selected Items from Both Programs

	Subjects ⟶	S-1	S-2	S-3	S-4	Group Mean
Track Monitor Program	"New"	3.1	3.6	3.1	1.5	2.8
	Cross	7.8	8.8	4.1	5.3	6.5
	Naive	4.1	4.1	---	---	4.1
	Total Mean					4.5
Intercept Director Program	"New"	1.9	5.7	3.2	.6	2.8
	Cross	3.8	3.2	1.9	3.8	3.2
	Naive	4.4	11.5	7.0	7.0	7.5
	Total Mean					4.5

Since research on the effect that errors have on learning has not been conclusive, it is not possible to say that the 4.5% average error score on these programs is too high (or perhaps, heretically, too low). The aim, however, was to make it as low as possible, and while this was achieved for some subjects, it is clear that many made a considerable number of errors.

Written response errors were not distributed evenly through the two programs but tended to cluster together. Thus, for the sample selected, 4% of the responses analyzed for the IND program accounted for 27% of the errors; 38% of the responses accounted for all of the errors. For the TM program, 4% of the responses accounted for 40% of the errors and 24% of the responses accounted for all errors. To the extent that response errors clustered together, there is reason to suspect that the cause of these errors was in the way the program frames built up those particular responses rather than random kinds of inattentive behavior, etc., on the part of the individual trainees. Reinspection of the program in these areas revealed that this was indeed the case.

A check was made on one part of the TM program where errors clustered together to see if this phenomenon had any effect on a test item dealing specifically with that portion of subject matter. An analysis of that test item revealed that the percentage of correct responses was higher (over 90%) than the average scores for the TM test for all groups. Thus, response errors made in a particular portion of the program did not, in this instance, seem to produce performance degradation, although the overall relationship between response errors made by a subject and his test scores was in the expected direction. This, and other interactions, will be discussed in the next section.

Discussion of program data.

Some of the relationships between the various scores and other program measures were briefly indicated in the previous discussion. To help provide more specific answers to questions relating to the interaction between measures taken within the program and test and questionnaire results, a rank-difference correlation analysis (rho) was performed on certain of the data. Since the number of cases is small, and much of the data was rather gross and not obtained under

carefully controlled conditions, the use of the rho for analysis was considered appropriate (McNemar, 1949). This material is presented as a series of hypotheses which suggest themselves as being the most interesting and revealing, followed by the results of the correlation analysis and a short discussion of the support this analysis gives to the hypotheses.[1]

Hypothesis 1: Trainees who make the fewest number of response errors in the program will tend to learn more and thus score higher on the final test.

This hypothesis was tested by using data consisting of the percentage of written response errors made by each subject (Table 6) and the percent of items scored correctly by the subject on the final test (Table 2). The calculated rho for this relationship is +.55 which is significant at the .01% level. As noted above, test scores are sometimes under the control of factors other than response errors in a particular portion of the program, but the general relationship between these two variables holds in the predicted direction.

Hypothesis 2: The more experience a trainee has had as an IND or TM the higher he will score on the final test.

The correlation between the two variables of months of experience and test scores was +.46 which is significant at the .05% level. The relationship is in the predicted direction, although there were a number of trainees who, while having no experience as an IND or TM (naive group), scored rather well on the test. It may be that motivation to learn was lower for those who felt that perhaps they did not need the training program since they were already working at these positions. The latter point is, if not supported, at least not counter-indicated by Hypothesis 7 below. In addition, since the two programs were designed to bring naive subjects up to high levels of competence, the fact that this relationship is not as high as one might initially expect is testimony to the success with which this goal was accomplished.

[1] The data presented in these correlational analyses are derived from the experimental training groups only, and do not, of course, include the experienced control groups who did not receive either of the programs.

Hypothesis 3: The faster the trainee proceeds through the program, the higher his test score will be.

The notion here is that speed and ability are correlated due largely to the amount of knowledge the trainee brings with him to the program. The rho for this relationship was +.31 which is not significant.[1] While some trainees may have worked more rapidly because they learned faster or were more highly motivated or knew more to begin with, others, it seems, worked faster for less sound reasons.

Hypothesis 4: The more general background experience in SAGE and/or the manual system, the higher the score will be on the final test.

The calculated correlation between these measures was -.17. While apparently experience on the job as a TM or IND could not help but have a positive influence on test results, general experience in SAGE not directly related to either task definitely did not appear to help in performance on the final test. Interference effects from similar tasks may account for at least some of this lack of interaction between these two variables.

Hypothesis 5: The fewer the number of days spent on the program, the more continuity the program will have and the higher the score will be on the final test.

This relationship was calculated from the number of days spent on the program (Table 5) and the score on the final test. The computed rho for this relationship is +.05 which is, of course, not significant. It is surprising that there is so little apparent relationship between these two factors. While retention studies were not done as part of this research, the extended length of time between the beginning of the program and the end of the program for some subjects (up to 25 days and averaging over 12), along with this apparent lack of relationship with test scores, would tend to indicate that retention scores, had they been obtained, may have been fairly high. Contending against this hypothesis is the fact that

[1] For N - 2 = 20 degrees of freedom, a rho would have to be .42 at the .05 level and .54 at the .01 level to be considered as having occurred by chance only five out of 100 times or one out of 100 times respectively.

the material in the programs tends to be accumulative, with frequent internal reviews. Thus, while some forgetting would no doubt take place during nonprogram intervals, the material lost could be brought back up to strength in succeeding sections of the program.

Hypothesis 6: The more background experience in the SAGE and manual system, the faster the trainee will proceed through the program.

This hypothesis was rejected since the computed rho was found to be -.12. Not only does general SAGE experience not help in terms of the test score received but it does not seem to result in the trainee's progressing through the program more rapidly.

Hypothesis 7: The more experience a trainee had with SAGE and the manual system, the less valuable the program would appear to him and the lower his questionnaire score.

A negative correlation was predicted and while not significant, a correlation in this direction of -.31 was computed. As some of the questionnaire remarks indicated, a number of the trainees were of the opinion that programs of this type were particularly suitable for those who had no SAGE experience and less suitable for those who had SAGE experience.

Hypothesis 8: The more positive one's attitude toward this type of training material, the higher the score on the final test.

This hypothesis was not supported by the questionnaire scores and test scores. The computed rho was -.17. This relationship is probably interacting with the IND/TM experience and test score relationship. Those with the most on-the-job training tended to be the most critical of the program but they also tended to score higher on the tests (see Hypothesis 2).

In summary, the two important interactions of performance during training and job experience with proficiency test results, held up. The fact that close relationships were not found between the other variables should not be surprising. The complexity of the training materials and the diverse backgrounds of the

trainees who went through the programs would have a tendency to attenuate relationships that may otherwise have been exhibited. However, the above results have been presented for their suggestive value.

III. DISCUSSION AND EVALUATION

The results of the on-the-site field tryouts of both the TM and IND self-instructional programs fully support the feasibility of using such materials for the teaching of basic job knowledges and skills as initial training, cross-training, or transition training programs for otherwise qualified personnel. Properly prepared and properly supported, such programs will teach a great deal of material in a relatively short period of time. In addition to achieving their objectives, the two programs used in this study were viewed favorably by the training population, the great majority of them recommending that many, if not most, future Air Force training programs be case in the same self-instructional format. Thus, the programs and presumably the concept, were accepted by the using population.

This study has provided support for the one basic question -- Will they work? However, factors other than the demonstrated capacity of these self-instructional materials to teach effectively and efficiently will of necessity play a role in determining whether or not such programs should be adopted for future training needs. Retention, transfer, competent programmers, long-range acceptability, and cost are among the important problem areas, contributions to which can be made only by continued application and evaluation. (See Eckstrand, Rockway, Kopstein, & Morgan, 1960 and Mayer, 1960 for discussions of many of the problems associated with the application of self-instructional methods and devices in a military setting.)

In addition to these matters of application, programming techniques themselves are being refined and new approaches tested in vigorous research activities that are bound to influence the nature of programming techniques in the future. The application of computers to programming, not only to mediate so-called self-organizing programs, but to aid in analyzing and developing programs, open up areas of tremendous potential -- areas that seem bound to influence profoundly the self-instructional concept as it is presently understood. Thus, while this study supports the feasibility of using certain kinds of self-instructional materials and techniques which have the support of current research and application

efforts, the field itself moves ahead into other areas, requiring new efforts in application and feasibility.

Thus it will not be claimed here that only programs prepared the way the TM and IND programs were prepared, and only programs using equipment like these programs used, will work effectively. However, the two programs under discussion have demonstrated their capacity to teach. Therefore, at least at the time of writing, the approach and techniques used in this study are offered in the way of general guidance for the development of programs aimed at similar goals, improving that which worked best, doing differently, or not doing at all, that which worked less well. The other reports in this series have critically discussed in detail how training requirements and objectives were formulated, how the TM and IND tasks were approached and analyzed, how self-instructional techniques were related to task characteristics, how the programs were prepared, what they consisted of, and how the functional characteristics of the teaching devices and auxiliary equipment were derived and subsequently applied to the presentation of the completed materials.[1] The statements below summarize the general recommendations drawn from the above noted reports, and are supported by the fact that the two SAGE programs demonstrated their teaching effectiveness as documented in this report.

1. Program goals and objectives must be clearly and precisely defined, preferably in terms of exactly what the trainee should be able to do and just what he needs to know when he completes the program.

2. The task analysis must precede program development and should be aimed specifically at the criterion or terminal behaviors defined in Step 1. These behaviors must be reduced to a level that assumes no knowledge or skill that is not brought to the program by the trainees.

[1] See the Foreword for the titles of these other documents.

3. Content of the program should be based primarily on this analysis and not on previously prepared documents or training syllabi. Their objectives are usually different.

   (Only if it is certain that program goals and objectives are to teach the same material in self-instructional format that is presently taught in conventional training format, might Steps 1 through 3 be omitted.)

4. The program itself should be cast in small step, continuous-discourse format with a variety of response modes available for use with each frame, including written, pointing, and covert. Responses should be relevant and contextually cued. Correction should be provided to the trainee for each response made. Exceptions to this format must be allowed, as in the case of the TM and IND programs where discrete-item, paired-associate material (e.g., phonetic alphabet, brevity code) was found, through experimentation, to be handled more effectively in flash card format.

5. The program should be self-paced and prepared only for individual instruction.

6. Separate programs and/or segment level and frame level branching[1] should be used to account for variations in aptitude levels, experience levels, and other factors that may influence the optimal program configuration as it interacts with the trainee. Which approach to use depends, in part, on the amount of variation that exists in these factors.

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[1] Segment level branching refers to the omission of certain portions or segments of the program for those who demonstrate that they are already proficient in that particular area. Frame level branching is the typical by-pass of a certain limited number of frames based on the correctness of a response to a particular frame.

7. Self-instructional devices should be selected which allow the programmer to utilize a variety of response modes and, otherwise, to permit the application of programming techniques which are found to be needed. Where operational equipment is used in the performance of the task, it should be functionally simulated, and practice with the simulated display and controls should be integrated with the self-instructional program.

8. Where criterion requirements or terminal behaviors are likely to change frequently and/or severely (as is the case in SAGE and other L-system tasks) provision must be made for the accommodation of such changes in the program. These changes should be written as separate programs for use by those already on the job and integrated into the existing program for those who are yet to receive training.

The TM and IND programs used in this study followed all of these general guides but some better than others. In what areas can future similar programs benefit from inadequacies found in the present programs? Where should they concentrate efforts on doing better?

Better frames can always be written, just as better books can always be written. In general, however, more effort should have been directed toward development of frames that would be interesting and challenging to the trainee. The most typical negative reaction to the frames was that they were "too repetitive," "too dull," "soporific," etc. Somehow, effective review, gradual build up and repetition of items, which are all necessary elements in developing high response strength, must also be made to appear interesting. Ability to do this seems, at present, to be something of an art, and its implementation in the TM and IND programs was not always successful. More analogies, more problem situations, more opportunity to apply learned material in new areas under new conditions would all have helped to make these programs more interesting and these must be considered important elements in the development of future small step,

continuous-discourse programs.

Closely related to the above problem is an area which was purposely not given attention in this study and which obviously should be given attention in future similar applications of self-instructional programs. A single program cannot provide optimal instruction in basic job knowledge for naive trainees, cross-trainees, and "new" trainees. It is unavoidable that material on which the naive trainee needs much drilling will either be known or partially known by the cross or "new" trainee and thus require less emphasis. While some frame level branching was used in the IND program to account for variations in knowledge level there was no effort made to provide for grosser segment level branching which would have more nearly met the different needs of the various groups of trainees.[1]

Multi-track programs are more difficult to write, of course, requiring some means of deciding what portion of the program should be given to a trainee (or, less sensitively, to a group of trainees) and some means for physically accommodating these various tracks. For the programs under discussion, a training package more closely tailored to the needs of the "new" and cross-training groups could have been provided by thinning out sequences, i.e., removing the early frames with strong prompts and reducing the number of repetitions and length of reviews but otherwise retaining the basic structure of the programs. The resulting programs would have been less boring to the "new" and cross trainees and probably more efficient. It should be remembered, however, that the "new" and cross groups learned a great deal of new material. The overlap between basic job knowledge for one operator position with that of another position is not as great as may be imagined. No one who works in SAGE needs to be told "what SAGE is" when he is transferring to a new job as the trainees were told in a few early frames of the TM and IND programs, but he does need to be told a good deal about how to take console actions and what decisions he must make on the new job, and these kinds of things comprise the bulk of both

[1] The one exception to this was the elimination of the flash card segment covering the phonetic alphabet for those IND trainees who indicated that they already knew it. Proficiency test results, however, supported the notion that such verbal reports of knowledge are not reliable and should not be used as a basis for determining segment level branching.

programs. So that it will not appear that contrary propositions are being simultaneously proposed, the above comments can be summarized as follows:

1. It was surprising how much of the material in the two programs was needed by the "new" and cross-trainees even though the programs were designed primarily for use by naive trainees. Their test scores, while higher than the naive test scores, still show room for improvement. Even experienced personnel, according to their scores, would benefit from at least some of the material in the programs.

2. "New" and cross-trainees do, nevertheless, bring to the programs more general information, more knowledge, and probably more "SAGE aptitude" than do the naive trainees. Thus the programs, to be maximally efficient and minimally boring, should take advantage of these factors.

Having considered proper preparation there remains to be considered proper support. A few comments on this important area will complete the discussion of these materials. Self-instructional should not be interpreted as meaning self-supporting or even necessarily self-administering. For one thing, programs must be kept current, and this requires program revision by qualified personnel. SAGE model changes, for example, would require a review of the entire program and a revision of those materials affected by the change. Interim changes would need to be collected and inserted into the program or covered in an external "change" program.[1] Since each Direction Center has its own phasing for incorporating model changes and even its own adaptation to these changes, program revisions might

[1]The TM and IND programs were modified from Model 5 to Model 6 before being released for field trials. A discussion of the problems this raised, how they were met, and suggestions for meeting them in future programs are contained in ESD-TN-61-52, "Training requirements for the development of prototype self-instructional programs covering basic job knowledge for SAGE Track Monitor and Intercept Director operator positions."

better be handled on-the-site. This would require qualified programmers at each Direction Center.[1]

The programs developed for this study required close monitoring while they were being administered. In part this was due to the prototype nature of the materials and equipment, the close observation required under experimental conditions, and the extra administrative burden imposed by the questionnaires, biographical forms, tests, etc. Modifications in equipment and materials could reduce this work load considerably (for example, if the devices were self-loading), but a monitor "on call" is recommended for programs of this type, particularly if trainees are grouped together (see Figure 1, page 5).[2] Monitors, of course, would not need special qualifications other than general familiarity with the programs and the equipment. They need not necessarily be subject matter experts nor need they have full qualifications as programmers (although these traits would be helpful).

Equipment, including teaching machines and any auxiliary equipment associated with the self-instructional materials, must be maintained in proper working order. This requirement should not be left under the control of chance factors but should be administratively incorporated into the training structure with space parts, tools, manuals and qualified personnel available as needed.

This study has demonstrated the feasibility of developing and using self-instructional materials and associated equipment for on-the-site training of SAGE operators in basic job knowledges and skills. There is no reason to believe

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[1] AFCCDD-TN-61-30, "Handbook for the preparation of self-instructional materials for SAGE operators" is designed to aid Air Force training personnel in the application of programming techniques and principles to the development of self-instructional training programs for SAGE and similar L-system tasks.

[2] A discussion of the equipment used for the TM and IND programs and suggestions for modifications that would reduce monitoring activities is contained in ESD-TN-61-47, "Characteristics of self-instructional devices to meet training requirements for the SAGE Track Monitor, Intercept Director, and related system-operator positions."

that this capability will not transfer to fully operational settings for similar tasks and for protracted time periods if proper attention is given to the preparation and support of such programs. Many things are yet to be learned about programming techniques and about their implementation. It is clear, however, that self-instructional materials can currently contribute to the building and maintaining of job proficiency provided continued diligence is exercised in the development, application, and support of such materials.

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APPENDIX A

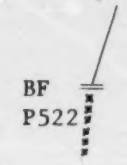
Track Monitor Proficiency Test

1. It is important that the TM see the merit of tracks being displayed on the SID. Which Feature Switch must be on to see track merit?

2. Which Feature Switch must be on to see track identity?

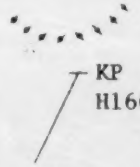
3. What information is controlled by the "C" Feature Switch?

4. Tell the identity, the merit, and the flight size of this track.



5. What kind of radar data are being shown by track P522? Are the data correlated or uncorrelated?

6. Tell the identity, merit, and flight size of this track.

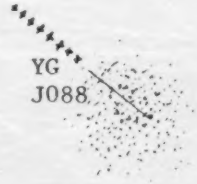


7. What kind of radar data are being shown by track H166? Correlated or uncorrelated?

8. Which action should you take on track H166?

9. List all the steps you would go through in taking action on track H166. Be sure to tell exactly which wing panel buttons and switches you would press in and/or set. If you would use the light gun, be sure to tell the part of the track display at which the gun should be aimed.

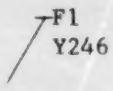
10. Which action should you take on track J088?



11. List all the steps you would go through in taking action on track J088. If you would use the light gun, be sure to tell the part of the track display at which the gun should be aimed.

12. List all the steps you would go through to exchange the symbologies of two tracks whose numbers are A123 and P357. If you would use the light gun, be sure to tell the aiming point for the gun.

13. No data can be found for track Y246. What action would you take on the track?



14. List all the steps you would go through in taking action on track Y246. If you would use the light gun, be sure to tell the aiming point for the gun.

15. If you wanted to know a track's altitude (its exact altitude, in feet, rather than simply whether it is low, medium, or high), what would you do?

16. If you wanted to know whether a track has gained or lost altitude in the past several minutes, and you have never known the track's exact altitude, what would you do?

17. There are two types (identities) of tracks which the TM does not normally handle. What are they?

18. The TM takes action only on established tracks. A track which is being cross-told in to your sector is not an established track. List other examples of nonestablished tracks.

19. List all the steps you would go through in calling up a DID for a track whose number is K111. If you would use the light gun, be sure to tell the aiming point for the gun.

20. List all the steps you would go through in taking a Track History action on a track whose number is G259. If you would use the light gun be sure to tell the aiming point for the gun.

21. Suppose that on your SID there is a Faker track which is in Fair merit, and a Round Robin track which is in Poor merit. Both tracks need to be reinitiated. Which track would you take action on first?

22. In order, list the identities of the five highest priority tracks, excluding Interceptors and Bomarcs.

23. Identity is one important criterion in determining priority of action. List some other criteria for determining priority.

24. Which of these two tracks would you take action on first? Why?

25. If the only "track" switch which the TM had ON was the Trouble Tracks switch, what would be the common characteristic of all the tracks appearing on the SID? Be specific.

26. During a mission, it is important for the TM to know whether weapons are committed against target tracks, and it may be important to know which Weapons teams are assigned to target tracks. The TM would also want to know merit, identity, track number, and flight size for target tracks. For nontarget tracks, the TM would probably want to see only merit, identity, track number, and nothing else.

    Now list the console switches which you would turn on to see these various things for the different types of tracks. Be sure to tell whether you would turn the switch to the right or to the left.

27. Suppose that the SID is crowded with tracks and data, and that all four of the radar data switches are on. There is an important track whose merit is failing and which needs to be reinitiated, but the TM cannot tell whether there is data which would enable him to take action. Which radar data switch(es) would he turn off, to help him see whether there is data which he can reinitiate?

28. What expansion level does the TM usually use?

29. If the TM wanted to spread the tracks on his SID out -- make them farther apart -- what should he do?

30. Here is a Track Tote.

```
K  J212

A  3752
F  02AC
S  0625
G  MK
G  2412
```

    What information is given in the top row?

31. List all the information given in the row beginning with "A." (The DID is shown in question 30.)

32. For the DID shown in question 30, list all the information given in the row beginning with "F."

33. List all the information given in the row beginning with "S."

34. What do the "G's" in the bottom and next-to-bottom rows of the DID stand for?

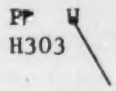
35. What is a Pending track?

36. What is the identity symbol for a Pending track?

37. What is a Faker track?

38. If the TM wants to know whether a track is in crosstell status, which block(s) of the symbology would he look at?

39. What is the <u>source</u> of this manual input track?

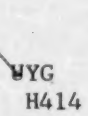


40. Which switch would you turn on to see your sector boundaries on the SID?

41. What are some of the causes of a track's getting "off its data?"

42. What action should you take on a track whose merit is deteriorating because it is "off its data?" (Assume it is a critical track.)

43. What is this track's identity?

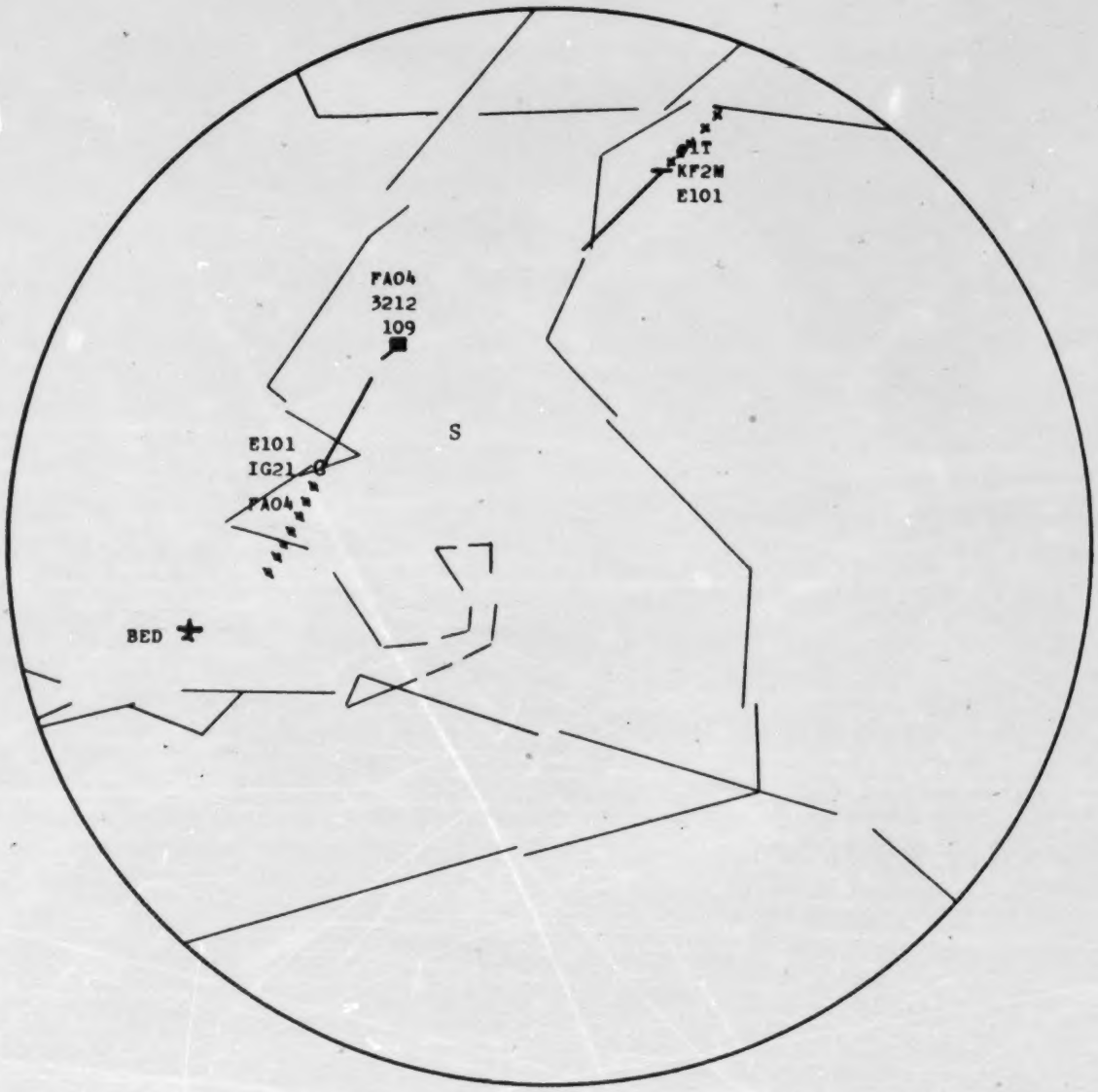


44. Assume that north is at the top of the page. What direction is track H414 (question 43) headed?

45. When the computer cannot handle an action, or when an action has been taken incorrectly, the alarm bell will ring, the alarm light will flash on, and the letter "C," "B," or "I" will appear in the top row of the DID. When a situation alarm occurs, what should the TM do?

APPENDIX B

Intercept Director Proficiency Test


KF2W
E101
FA04
3212
109
S
E101
FA04
BED

I. Interpretation of SID Displays

(The SID on the adjoining page is used for Questions 1 through 9 in this section and for Questions 1 and 2 in Section III.)

1. What kind of a mission is represented?

2. What is the home base of the interceptor?

3. What kind of data does the interceptor have?

4. What kind of data does the target have?

5. The interceptor symbology shown gives you 7 different pieces of information. Write down what these are. (They can be in any order.)

6. The Intercept Point Display on the SID gives you the kind of tactic employed. What shows you this?

7. At this point in the mission the intercept point shown also gives 4 other pieces of information. What are they?

8. When the interceptor reaches offset point a change occurs in one of the items of information presented in the intercept point. What is it?

9. The target track symbology contains 8 items of information. What are they?

II. Attention Displays

If the following attention displays appeared on your SID, what information would they provide you about your mission?

1. ■ ■ ■ ■
   F O L D

2. ■ ■ ■ ■
   A C 1 1

3. ■ ■ ■ ■
   F I N L
   P 3 6 0

4.
   I ■ 4 0

   S 0 5 0

III. Radio Transmissions

1. Supposing, on our SID, you saw a stranger in the position indicated by "S" heading toward FA04. Using the scale 1 inch equals 50 miles, how would you indicate this stranger to the pilot?

2. Again using our SID (same scale), how would you report the bearing and range of the target to the pilot of FA04? (The interceptor has not reached offset point.)

3. How would the above transmission differ after rollout?

4. How would you transmit to the pilot the information contained in the FINL Attention Display we used on page B-1?

5. There are at least 6 other standard subjects that are covered in every mission by radio transmission between pilot and IND. Name as many as you can. (Parachute check, as an example, has been listed.)

IV. Phonetic Alphabet

In the space provided next to each letter write the phonetic equivalent of that letter. Spelling will not count.

T	V
M	H
F	O
L	E
U	W
B	N
S	A
G	P
K	X
R	I
J	Y
C	D
Q	Z

V. Brevity Code

Following is a list of selected words from the brevity code. Write the meaning for each of these words (or terms) in the space provided.

Oranges Sour --

Howme --

Bent Weapon --

What State --

Dolly --

MI --

Popeye --

Roger --

Affirmative --

WILCO --

May Day --

Ammo Minus --

Angels --

VI. Interpretation of DID Displays

Following are two sample DIDs, one an Interceptor Track DID and the other an Interception DID. On the following pages these DIDs are reproduced with space provided next to each line for you to write down the information contained in that line.

Interceptor Track DID

```
I  AE07
   GOFT
A  275S
F  02
S  0812
F  GAR1
I  H081
I  1423
E  3197
F  1189
```

Interception DID

```
V  BC21
I  E318
C  180S
T   20M
A  270S
B   45S
D   105
A  335C
A  280P
A  3202
```

Interceptor Track DID

I	AE07
	GOFT
A	275S
F	02
S	0812
F	GAR1
I	H081
I	1423
E	3197
F	1189

Interception DID

V	BC21
I	E318
C	180S
T	20M
A	270S
B	45S
D	105
A	335C
A	280P
A	3202

VII. Requesting DIDs and Other Actions

List the steps in requesting a Target Track DID on the left side of the DID display, first using the light gun and second using the Activate Button.

1. Light gun.

2. Activate Button.

3. How would you request an Interception DID on the right side of the DID display?

4. How would you take Airborne Action using the Activate Button?

5. What steps would you take to put your interceptor On Command Tracking using the light gun?

APPENDIX C

Questionnaire

The purpose of this Questionnaire is to get your opinion of the program that you have just completed. Since the program represents a new approach to training, we are anxious to learn just how you feel about it. Try to give as accurate an answer as you can to each item. You will indicate your answer by checking the statement that <u>best</u> represents your opinion.

1. Think for a moment how the material covered in this program could have been covered in a conventional training program, where you would be in a class with 15 or 20 other trainees, listening to lectures, watching demonstrations, reading assignments from manuals, etc. How would you say the present program would compare with this more conventional type of program?

_____ I like this kind of program a lot more.
_____ I like this kind of program a little more.
_____ I like them about the same.
_____ I like the conventional training program a little more.
_____ I like the conventional training program a lot more.

2. Based on your reaction to the present program, what type of program would you recommend be used by the Air Force for future training courses?

_____ I would recommend that almost all programs be of the conventional lecture, demonstration type.
_____ I would recommend that the majority of programs be of the conventional lecture, demonstration type, with a few programs like the one I just completed.
_____ I would recommend that about half be of the conventional type and about half of the new type.
_____ I would recommend that the majority of programs be of the new type, with a few programs of the conventional type.
_____ I would recommend that almost all programs be of the new type.

3. How much would you say you learned from this program?

_____ I learned a great deal.
_____ I learned quite a lot.
_____ I learned about an average amount.
_____ I learned some things but not too much.
_____ I didn't learn very much at all.

4. How would you rate the overall operation of the device you used -- the one that presented the cards to you?

_____ It was very convenient and easy to use.
_____ It was fairly convenient and easy to use.
_____ It was not very convenient or easy to use.

5. Make at least one statement concerning something you did not like about the device. (More are welcome.)

6. Let's turn to the console mock-up you used. How would you rate its overall usefulness?

_____ It was very useful.
_____ It was fairly useful.
_____ It was not very useful.

7. Make at least one statement concerning something you did not like about the mock-ups. (More are welcome.)

8. Should the program have made more or less use of the mock-ups?

_____ More.
_____ Less.
_____ Keep it about the way it is.

9. The flashing display was used to simulate the actual flashing on a real console. Is there anything you would care to say about the way this flashing unit worked?

10. One final item about the console mock-ups. Would you say that your mock-up should have more switches and buttons on it than it did?

_____ Should have more.
_____ It was all right the way it was.
_____ Should have less.

11. Sometimes the program covered a point more than once in order to be sure you got it. In general would you say that the program

_____ repeated things too often.
_____ repeated things about the right number of times.
_____ did not repeat things often enough.

12. Some parts of the program were on flash cards, such as the brevity code and the phonetic alphabet. What is your opinion of this method of instruction?

_____ I like them -- they did an effective job.
_____ They were all right -- did a fair job.
_____ I did not like them -- they did not do an effective job.

13. Would you say that more or less of the material should have been put in flash card form?

_____ More of the program should be in flash card form.
_____ Less of the program should have been put in flash card form.
_____ It is about right the way it is.

14. Some of you were provided with an automatic write-in device on which you recorded your responses to many of the cards. How would you rate the convenience of this device?

_____ It was very convenient to use.
_____ It was fairly convenient to use.
_____ It was not very convenient to use.

15. Is there any comment you would like to make about the use or operation of the automatic write-in device?

16. Some of you wrote your responses on material provided you in the form of regular note paper. How would you rate the convenience of this method of recording your responses?

_____ It was very convenient to use.
_____ It was fairly convenient to use.
_____ It was not very convenient to use.

17. Any comments you would like to make about this method of recording your responses?

18. In the space below we would like you to write down <u>any additional</u> comments concerning the program that you would like to make. Feel perfectly free to express your opinion, whether it involves something you found particularly good or bad.